MICRONTA®

Service Manual

22-183

LCD DIGITAL MULTIMETER
Catalog Number: 22-183

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WARNING – THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT DO ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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SPECIFICATIONS

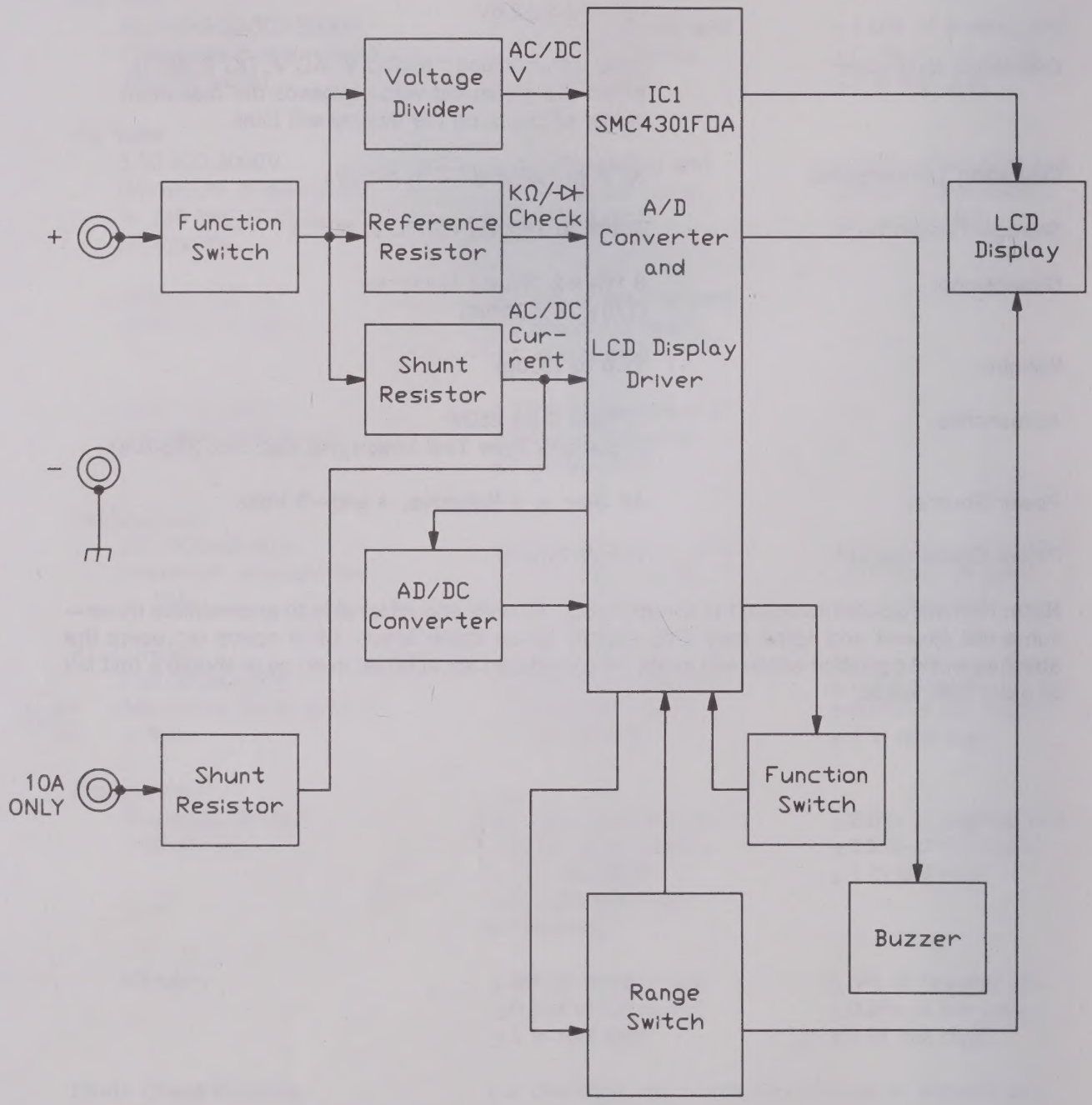
Display: 3 2/3-digit LCD

Accuracy	Nominal	Limit
DC Volts		
300mV-3-30-300-3000V (Maximum measurement = 1000 Volts)	±0.8% of reading and ±0.2% of full scale, ±1 in last digit	±1.0% of reading and ±0.2% of full scale, ±1 in last digit
AC Volts		
3-30-300-3000V (Maximum measurement = 750 Volts RMS) at 50/60Hz	±1% of reading and ±0.5% of full scale, ±1 in last digit	±1.5% of reading and ±0.5% of full scale, ±1 in last digit
45Hz to 500Hz at 30-Volt Range	±1.5% of reading and ±0.5% of full scale, ±1 in last digit	
500Hz to 10kHz at 30-Volt Range	±10% of reading and ±0.5% of full scale, ±1 in last digit	
DC Currents		
3-30-300mA-30A (Maximum measurement = 10A)	±1.5% of reading and ±0.2% of full scale, ±1 in last digit	±2.5% of reading and ±0.2% of full scale, ±1 in last digit
AC Currents		
3-30-300mA-30A (Maximum measurement = 10A	±1.5% of reading and ±0.5% of full scale, ±1 in last digit	±2.5% of reading and ±0.5% of full scale, ±1 in last digit
Resistance		
300ohm-3-30-300 – 3000kohm	±1.5% of reading and ±0.2% of full scale, ±1 in last digit +5 digit maximum at 300ohm	±2.0% of reading and ±0.2% of full scale, ±1 in last digit
30Mohm	±3% of reading and ±0.2% of full scale, ±1 in last digit	±5% of reading and ±0.2% of full scale, ±1 in last digit
Diode Check Function	For checking semi-conductors—open or shorted and normal.	
Continuity Function	Continuity buzzer sounds at less than nominal 295 ohm (±20 ohms) input resistance. Buzzer sounds 150ms (typical) when input is shorted.	

Input Impedance:	10 Mohms (DCV/ACV) more than 100 Mohms on 300 mV DC
Low Battery Indication:	"BATT" on the left of the display when batteries fall below 2.4V-2.6V.
Overrange Indication:	3000 with blinking "3"(DC V, AC V, DC I, AC I). When the measured value exceeds the maximum value, all digits on the display will blink.
Operating Temperature:	32°F to 122°F (0°C to 50°C)
Storage Temperature:	−4°F to 140°F (−20°C to 60°C)
Dimensions:	6 $^{11}/_{16}$ × 2 $^{15}/_{16}$ × 1 ¼ inches (170 × 75 × 32mm)
Weight:	11.6 oz (330g)
Accessories:	1) Fuse 0.5A 250V 2) Banana Type Test Leads (RS Cat. No. 278-704)
Power Source:	AA Size × 4 Batteries, + and − 3 Volts
Power Consumption:	10mW Typical

Note: Nominal specs represent the design specs. All units should be able to approximate these—some will exceed and some may drop slightly below these specs. Limit specs represent the absolute worst condition which still might be considered acceptable; in no case should a unit fail to meet limit specs.

BLOCK DIAGRAM



CIRCUIT DESCRIPTION

General

The Micronta LCD Digital Multimeter is based on one IC. IC1 (SMC4301FOA) consists of a dual-slope A/D (Analog-to-Digital) converter and a display driver.
IC1 (SMC4301FOA) measures voltage only, so other measured parameters must be converted to voltage by the peripheral circuitry. To measure current, shunt resistors are used. To measure unknown resistance, a constant current is applied and the voltage is measured.

AC/DC Voltage Measurement

When measuring voltage, input voltage (ACV or DCV) enters the voltage divider R1, R22, R23, and R24. The range is changed for the input voltage. When measuring DCV, the output from the voltage divider is compared with the reference voltage. The result is displayed on the LCD. When measuring ACV, the output from the voltage divider is applied to the AC-to-DC converter that consists of diodes (D3, D4), 7 resistors (R11-R16 and VR2), and 5 capacitors (C4, C5, C6, C7, and C8). The output from the AC/DC converter is compared with the reference voltage. The result is displayed on the LCD.

AC/DC Current Measurement

When measuring current, set the function switch SW1 to AC mA or DC mA and the range switch SW3 to the appropriate position for the input current. When measuring 3/30/300mA, the input current enters the 3/30/300mA current shunt and range switch SW3 through the fuse and the function switch. When measuring 10A, the input current enters the 10A current shunt R33 through the 10A terminal (not fuse-protected). If the function switch is set to AC mA when AC mA is input, the output from the current shunt goes to the AC/DC converter and is rectified by an analog switch in IC1. The DC voltage of the current shunt output or the AC voltage of the AC/DC converter output is compared in the IC with the reference to voltage. The result is displayed on the LCD.

Resistance Measurement

A ratio determines the resistance. When the function switch (SW1) is set to kohm, a series circuit is formed by the internal reference voltage, the selected reference resistors (R27, R28, R29, R30, R31, and R32), and the resistance to be measured. A ratio of the two resistors is equal to the ratio of their respective voltage drops. Since the value of the reference resistors is known, the A/D converter calculates the value of the unknown resistor as follows:

In the case of integration:

$$Vo(INT) = \frac{Rx\ (Unknown\ Resistance)}{Rref\ (Reference\ Resistor) + Rx\ (Unknown\ Resistance)} \times Vref$$

In the case of de-integration:

$$Vo\ (DE) = \left(1 - \frac{Rx}{Rref + Rx}\right) \times Vref = \frac{Rref}{Rref + Rx} \times Vref$$

$$\frac{Vo\ (INT)}{Vo\ (DE)} = \frac{Rx}{Rref}$$

PO1 and Q1 constitute the protection circuit from over-voltage (500 V AC, 1 minute max.).

Continuity Check

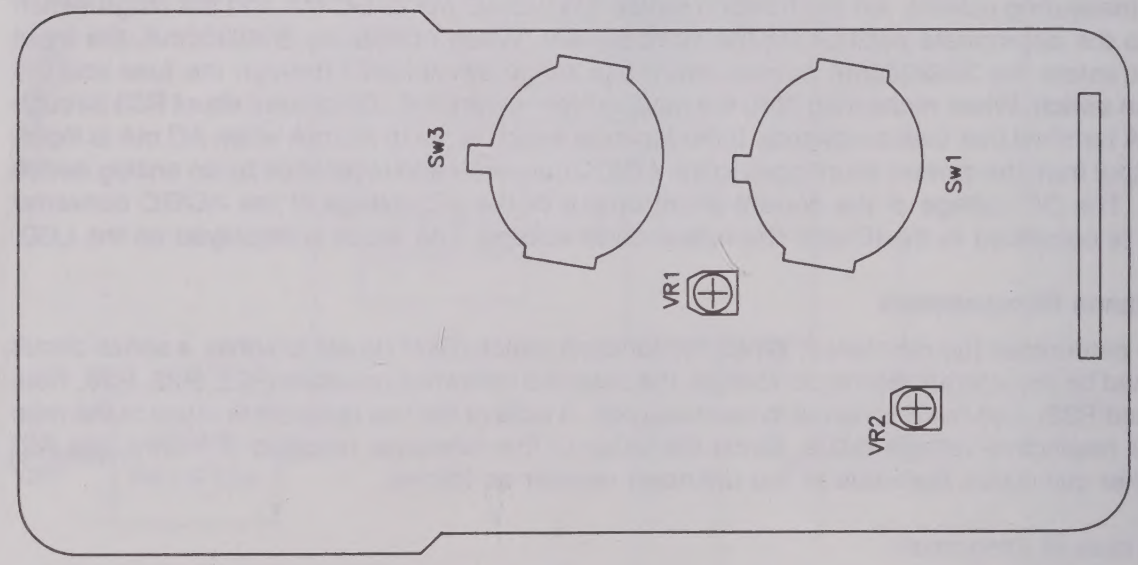
When the OFF/ON/CONT switch (SW2) is set to CONT and the function switch (SW1) is set to kohm, the range is held at the 320 ohm range and the oscillation circuit in IC1 operates. The buzzer (BZ1) sounds if the value is less than 295 ohms nominal.

Diode Check

Since open-circuit voltage between jacks is maintained at 3 volts in the diode check function, you can check continuity of most diodes, LEDs, transistors, etc. The display value during the diode check function is the forward voltage (2 V max.).

ADJUSTMENTS

Adjustment Points



Equipment Required

1. AC Calibrator 0–750V (+ –0.1% accuracy, 100Hz-1 kHz)
2. DC Calibrator 0–1000V (+ –0.05%)
3. AC Current Calibrator 0–300mA (+ –0.2%)
4. DC Current Calibrator 0–300mA (+ –0.2%)
5. Resistors: 1 kohm, 10 kohms (+ –0/1%), 70 kohms (+ –0.1%)
6. Millivoltmeter

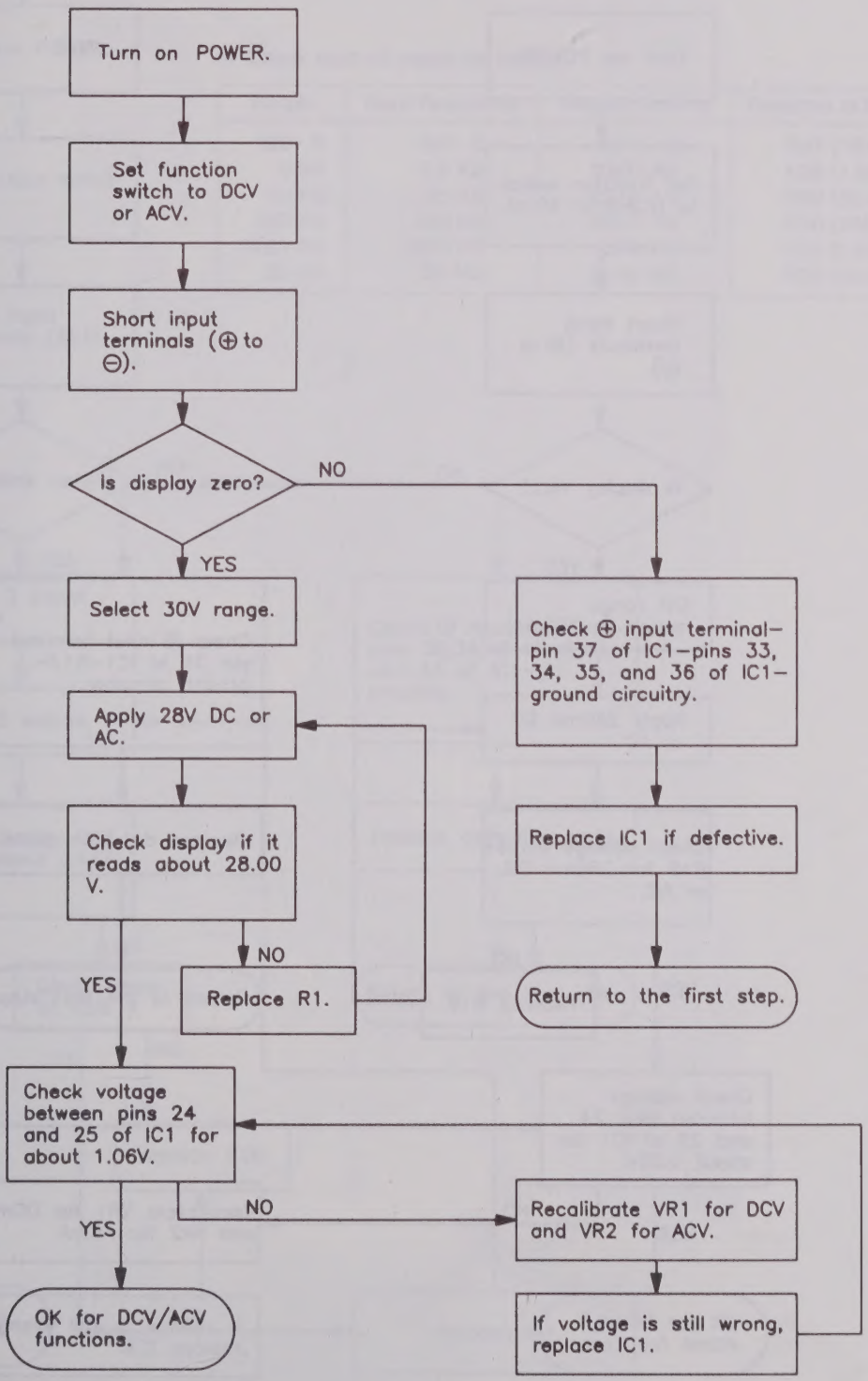
PROCEDURES:

Step	Control Setting	Connection & Input	Adjust	Adjust For
1	Set the OFF/ON/CONT switch to ON.			
2	Adjustment of DC Voltage Measurement Function			
	Function Switch: DC V	1) Connect DC Voltage Calibrator. 2) Apply 2.800V DC to input.	VR 1 (10 kohms)	Adjust VR1 so the display reads 2.800.
3	Adjustment of AC Voltage Measurement Function			
	Function Switch: AC V	1) Connect AC Voltage Calibrator. 2) Apply 28.00V AC to input (50 or 60 Hz).	VR 2 (200 kohms)	Adjust VR2 so the display reads 28.00.
4	Adjustment of DC Current 300mA Measurement Function			
	Function Switch: DCmA Range Switch: 300 mA	1) Connect DC Current Calibrator to input (+) jack and input (−) jack. 2) Apply 280.0 DC mA to input.		Display reading within spec? If not, replace R19.
5	Adjustment of DC Current 10A Measurement Function			
	Function Switch: DCmA Range Switch: 10A	1) Connect DC Current Calibrator to the input 10A jack and input (−) jack. 2) Apply 10.00A DC to input.	R33	Adjust the position of wire R33 so the display. reads 10.00.
6	Adjustment of AC Current 300mA Measurement Function			
	Function Switch: AC mA Range Switch: 300 mA	1) Connect AC Current Calibrator to input (+) jack and input (−) jack. 2) Apply 280.0 ACmA input.		Display reading within spec? If not, replace R19.

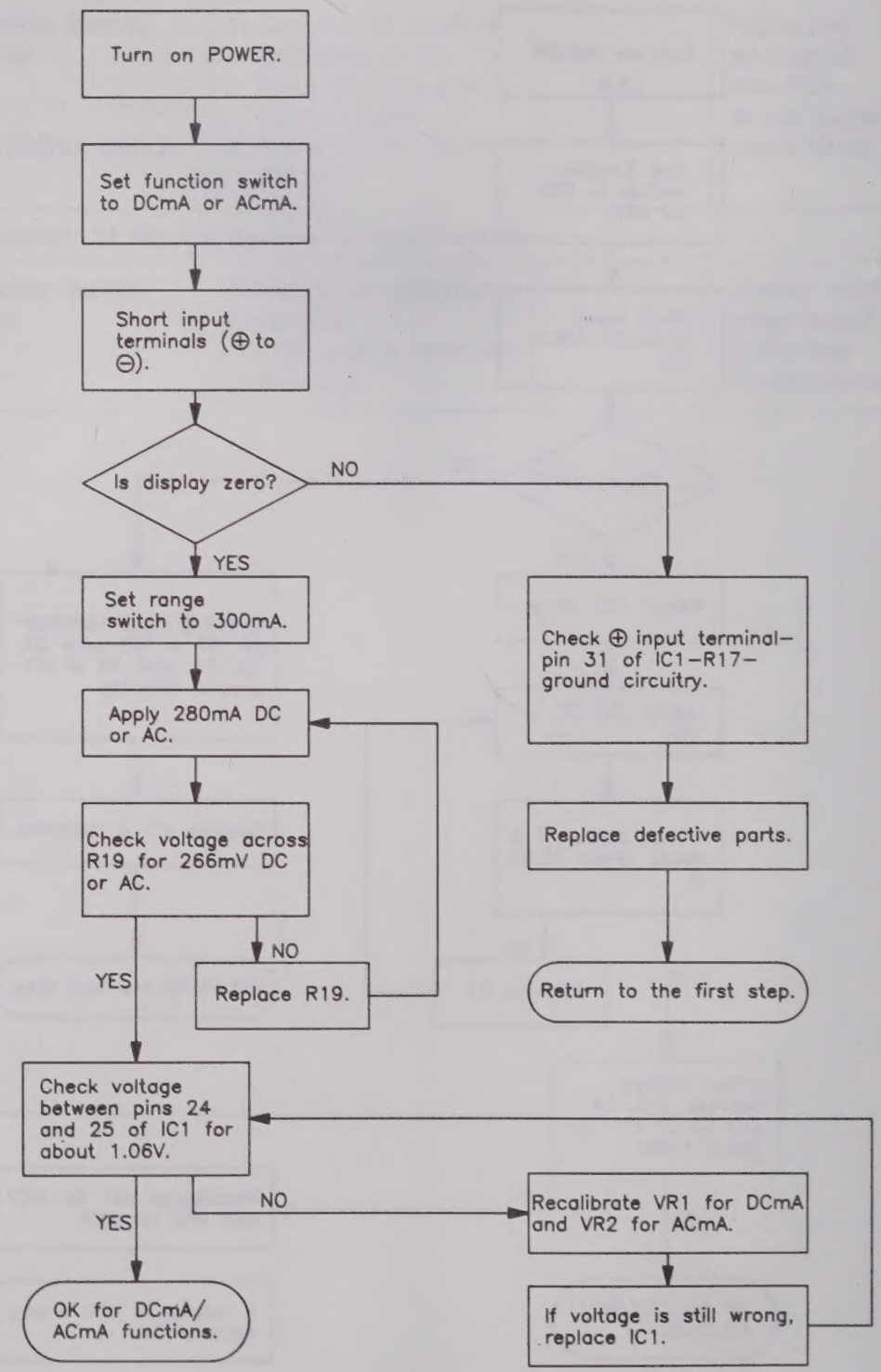
Step	Control Setting	Connection & Input	Adjust	Adjust For
	Adjustment of AC Current 10A Measurement Function			
7	Function Switch: AC mA 10A-300mA Switch: 10A	1) Connect AC Current Calibrator to the input 10A jack and input (–) jack. 2) Apply 10.00A AC to input.	R33	Adjust the position of wire R33 so the display reads 10.00.
	Adjustment of Resistance Measurement Function			
8	Function Switch: kohm	Connect the calibration resistance (1kohm and/or 10kohms) to the input.		Display reading within spec? If not, see Troubleshooting.

TROUBLESHOOTING

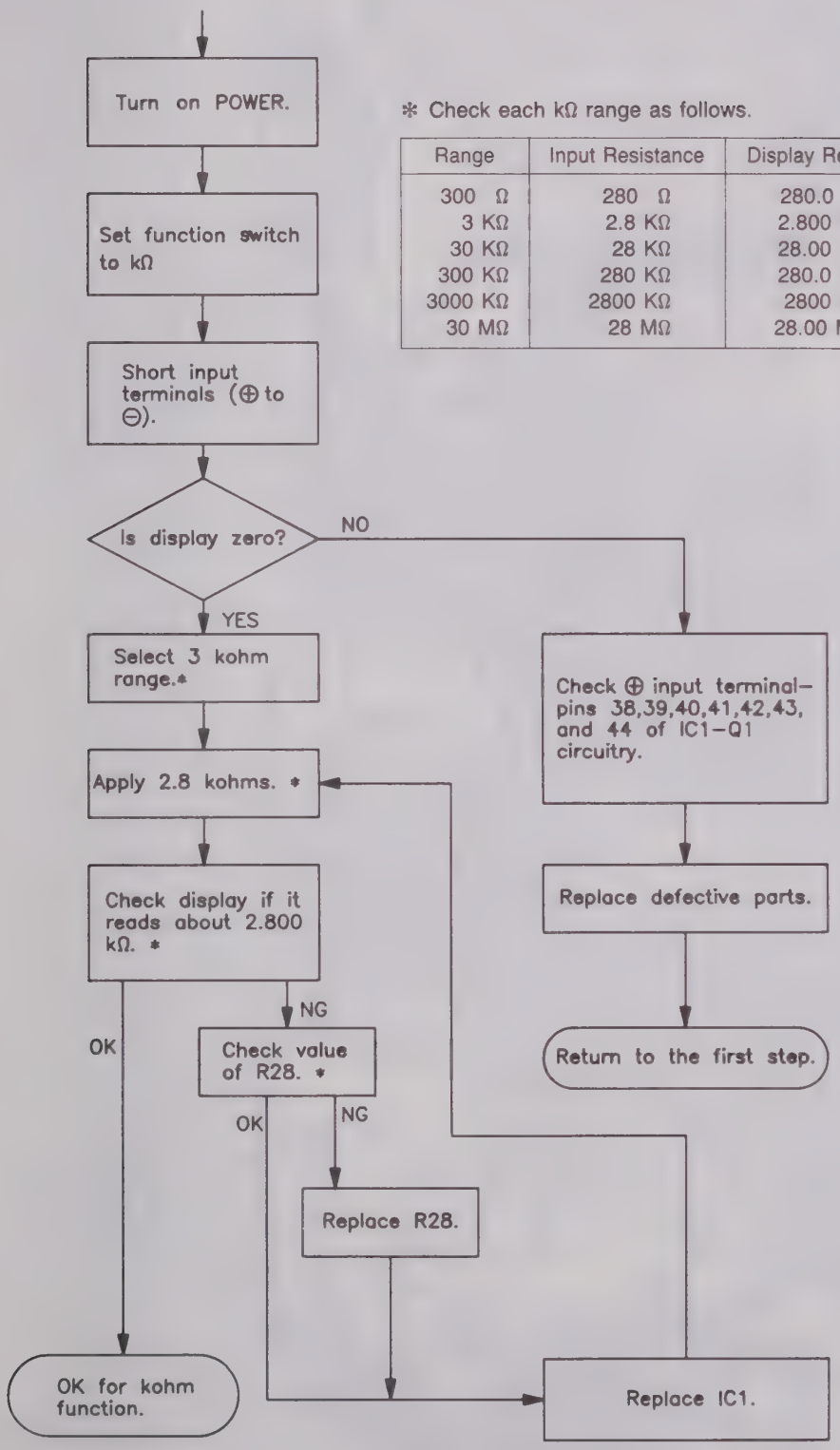
Troubleshooting of DCV/ACV Measurement Functions


Turn on POWER.
Set function switch to DCV or ACV.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Select 30V range.
Apply 28V DC or AC.
Check display if it reads about 28.00 V.
NO
YES
Replace R1.
Check voltage between pins 24 and 25 of IC1 for about 1.06V.
NO
YES
OK for DCV/ACV functions.
Check ⊕ input terminal–pin 37 of IC1–pins 33, 34, 35, and 36 of IC1–ground circuitry.
Replace IC1 if defective.
Return to the first step.
Recalibrate VR1 for DCV and VR2 for ACV.
If voltage is still wrong, replace IC1.

Troubleshooting of DCmA/ACmA Measurement Functions


Turn on POWER.
Set function switch to DCmA or ACmA.
Short input terminals (⊕ to ⊖).
Is display zero?
NO
YES
Set range switch to 300mA.
Apply 280mA DC or AC.
Check voltage across R19 for 266mV DC or AC.
NO
YES
Replace R19.
Check voltage between pins 24 and 25 of IC1 for about 1.06V.
NO
YES
Recalibrate VR1 for DCmA and VR2 for ACmA.
If voltage is still wrong, replace IC1.
OK for DCmA/ ACmA functions.
Check ⊕ input terminal–pin 31 of IC1–R17–ground circuitry.
Replace defective parts.
Return to the first step.

Troubleshooting of kohm Functions

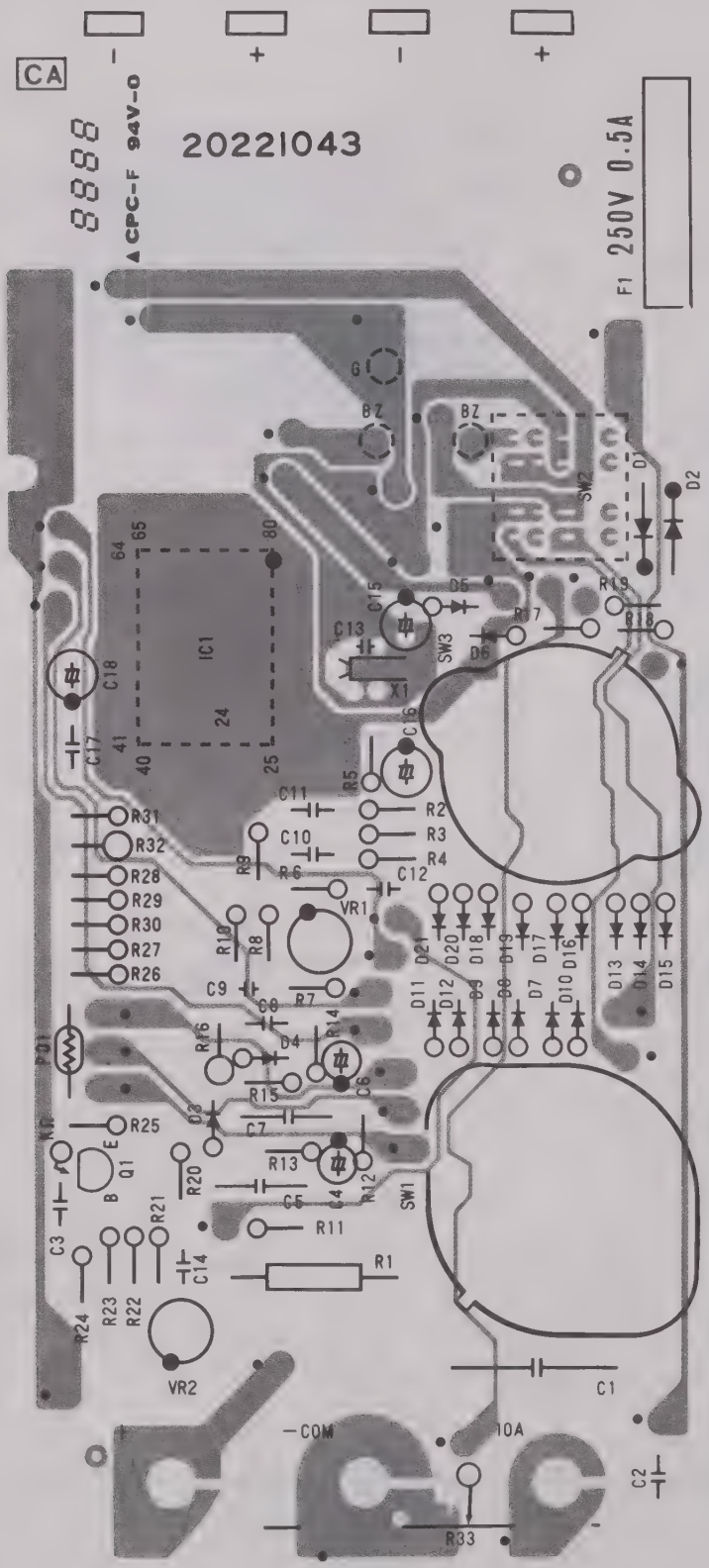


* Check each kΩ range as follows.

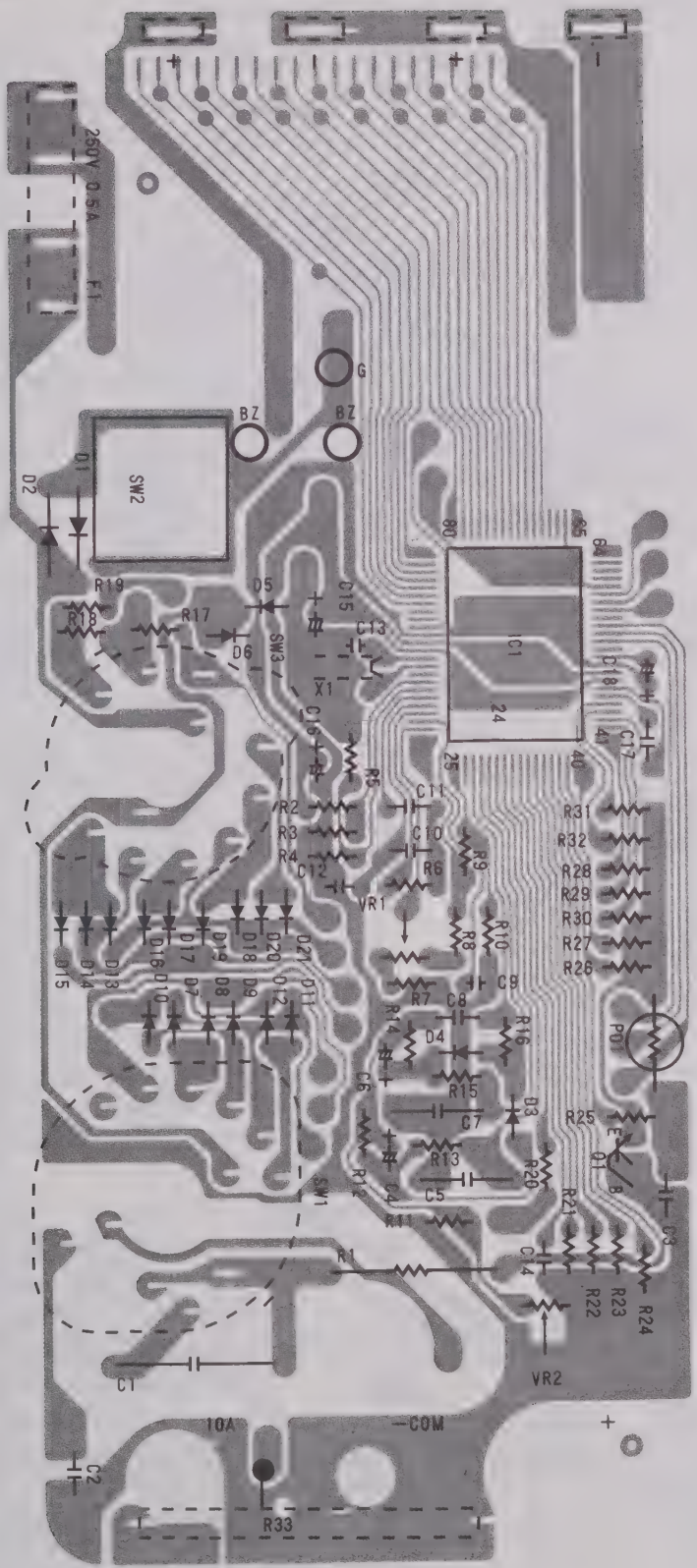
Range	Input Resistance	Display Reading	Resistors to Be Checked
300 Ω	280 Ω	280.0 Ω	R27 (164 Ω)
3 KΩ	2.8 KΩ	2.800 KΩ	R28 (1.64 KΩ)
30 KΩ	28 KΩ	28.00 KΩ	R29 (16.4 KΩ)
300 KΩ	280 KΩ	280.0 KΩ	R30 (164 KΩ)
3000 KΩ	2800 KΩ	2800 KΩ	R31 (1.64 MΩ)
30 MΩ	28 MΩ	28.00 MΩ	R32 (16.4 MΩ)

PRINTED CIRCUIT BOARD

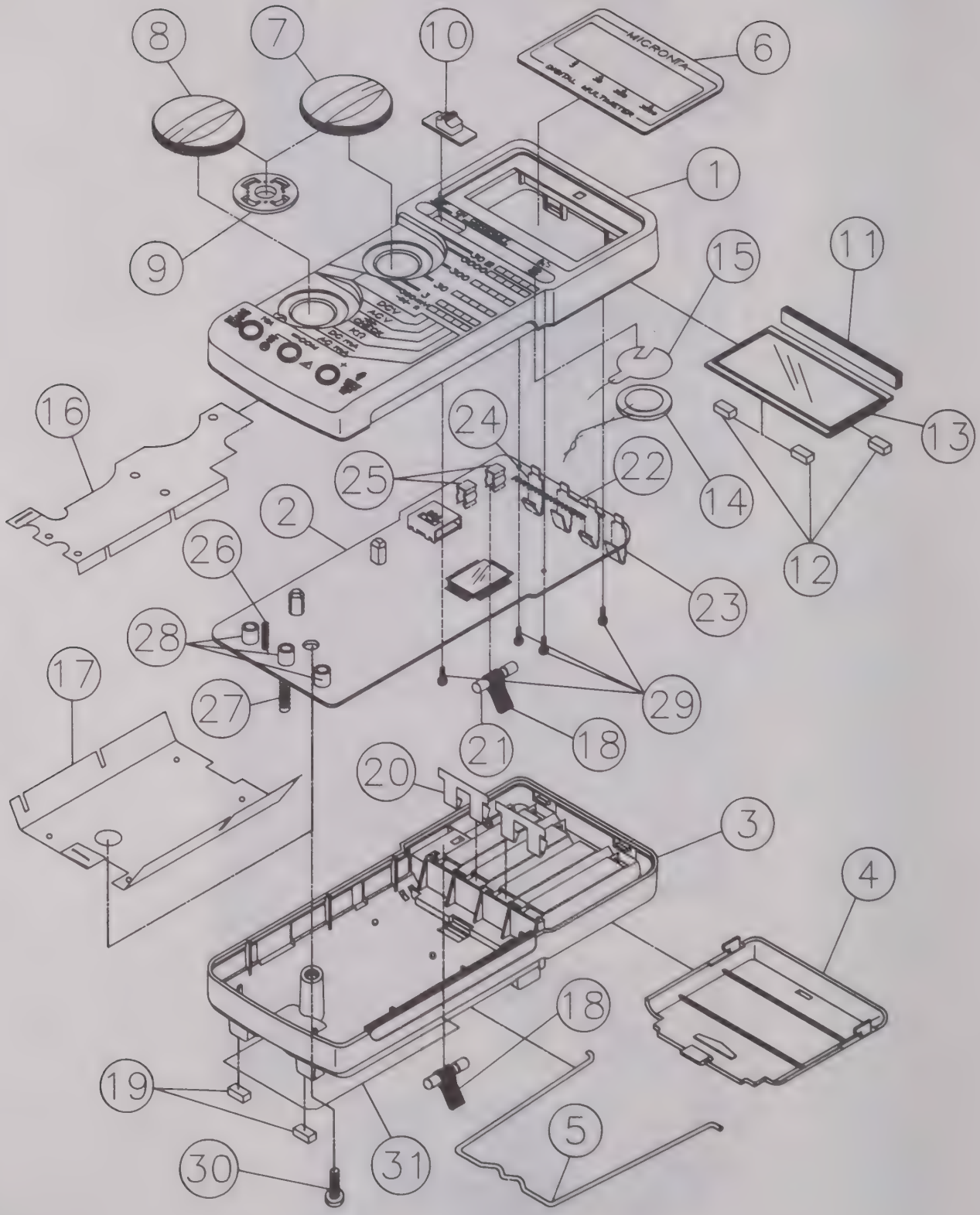
Top View



Bottom View


250V 0.5A
F1
BZ
BZ
SW2
D1
D2
R19
R18
R17
D5
D6
SW3
C15
C13
X1
C16
IC1
24
1
40
25
C18
C17
R5
R2
R3
R4
C12
C11
C10
R6
R9
VR1
R8
R10
R7
C8
C9
D4
R14
R16
R15
C7
C6
D3
R13
R12
C4
C5
R11
R1
SW1
C14
R31
R32
R28
R29
R30
R27
R26
PO1
R25
Q1
R21
R22
R23
R24
C3
VR2
C1
10A
COM
C2
R33
D15
D14
D13
D16
D17
D19
D18
D20
D21
D10
D7
D8
D9
D12
D11

EXPLODED VIEW



MECHANICAL PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
1	Cabinet, Top, ABS 94HB		601212660A
2	Assembly, PCB, Main		U-25799-
3	Cabinet, Bottom, ABS 94HB		601312260A
4	Cover, Battery, ABS		602110980A
5	Handle, Switch Cr-1		714010170A
6	Window, PVC Silk		713510930A
7	Knob, 21 ABS 94HB For Switch 3		652110460A
8	Knob, 21 ABS 94HB For Switch 1		652110380A
9	Slider, POM		436110110A
10	Knob, 90 ABS 94HB For Switch 2		659010320A
11	Connector, GL-025 (60x6.5x2.6) For LCD		199910760A
12	Spacer, Neop Rubber For LCD		852013810A
13	LCD, LTA6R70111		553510210A
14	Buzzer, 7BB-20-6		272010171A or 272010170A
15	Plate, Shield, C2600P Degreasing		473211500A
16	Sheet, Shield, PVC+AL Foil		473311370A
17	Sheet, Shield, PVC+AL Foil		473311380A
18	Ribbon, Nylon Cloth For Fuse 1		851400220B
19	Foot, Rubber		608010670A
20	Contact, Battery C5210R Ni-3		196110870A
21	Fuse, 250V 0.5A		251210510A
22	Contact, Battery C5210R Ni-3		196110860A
23	Contact, Battery C5210R Ni-3		198110840A
24	Contact, Battery C5210R Ni-3		198110850A
25	Clip, Fuse UF-0033#01		197303320C
26	Spring, Coil, SWP Ni-3 Large		434110450A
27	Spring, Coil, SWP Ni-3 Small		434110680A
28	Terminal, Tester, C3601BD Ni-3 For Test Leac		194510170A
29	Screw, Taptite 2x8 BT-B PCB/Top Cabinet		HCBB2008SY
30	Screw, Taptite 3x12 B T-B For Cabinet		HCBB3012SY
31	Label, Warning Sticker US		733311650A
	CA		733311660A
	BG/UK/AU		733311670A
Not Shown	Lead, Test, Banana Type		315010012D
Not Shown	Lead, Test, Banana Type ITI		315060020A
1,6,14,15,16	Assembly, Cabinet, Top		MT00221
3,5,17,19,20,31	Assembly, Cabinet, Bottom US/CA/AU/UK/BG		MT00222
29,30	Ext/Int Hardware Kit		HWK0220183
8,9	Assembly Knob For SW1 (Function)		MT00223
7,9	Assembly Knob For SW3 (Range)		MT00224

ELECTRICAL PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
	Assembly, PCB, Main		U-25799-
	Blank PCB		20221043*A
CAPACITORS			
C 1	M-Plastic 0.022 μF 1000V + – 10%		CFQMZA02KB or
	M-Plastic 0.022 μF 1000V + – 10%		CFQMZ223KZ or
	M-Plastic 0.022 μF 1000V + – 10%		CFQMZ223KE
C 2/ 3	Ceramic 0.01 μF 1000V + 80 – 20%		CKJPY103Z*
C 4	Tantalum 2.2 μF 16V + – 20%		CSEEG225M*
C 5	M-Plastic 0.22 μF 100V + – 10%		CFQMNA01KV or
	M-Plastic 0.22 μF 100V + – 10%		CFQMN224KZ or
	M-Plastic 0.22 μF 100V + – 10%		CFQMN224KE
C 6	Tantalum 2.2 μF 16V + – 20%		CSEEG225M*
C 7	M-Plastic 0.22 μF 100V + – 10%		CFQMNA01KV or
	M-Plastic 0.22 μF 100V + – 10%		CFQMN224KZ or
	M-Plastic 0.22 μF 100V + – 10%		CFQMN224KE
C 8	M-Plastic 0.1 μF 50V + – 5%		CFQMK104JL or
	M-Plastic 0.1 μF 50V + – 5%		CFSMK104JZ
C 9	Ceramic 390 pF 50V + – 10%		CK1HK391K*
C 10/ 11	M-Plastic 0.1 μF 50V + – 5%		CFQMK104JL or
	M-Plastic 0.1 μF 50V + – 5%		CFSMK104JZ
C 12	*Mylar 0.01 μF 50V + – 10%		CQ1SK103K*
C 13	Ceramic 10 pF 50V + – 1%		CC1BK100F*
C 14	Mylar 0.01 μF 50V + – 5%		CQ1SK103K*
C 15/ 16	Electrolytic 4.7 μF 50V + – 20%		CEB1K475M*
C 17	M-Plastic 0.1 μF 50V + – 5%		CFQMK104JL or
	M-Plastic 0.1 μF 50V + – 5%		CFSMK104JZ
C 18	Electrolytic 2.2 μF 50V + – 20%		CEB1K225M*
DIODES (All Silicon Type, Unless Noted Otherwise)			
D 1/ 2	10D2 Protection		SDSIT0002- or
	SR1K-4		SDSIT0027-
D 3/ 4/ 5/ 6	1N4148 SW		SDSIT0006- or
	1N4148		SDSIT0146- or
	1N4148		SDSIT6049-
D 7/ 8/ 9/10	1N4148 SW		SDSIT0006- or
	1N4148		SDSIT0146- or
	1N4148		SDSIT6049-
D 11/12/13/14	1N4148 SW		SDSIT0006- or
	1N4148		SDSIT0146-
	1N4148		SDSIT6049-
D 15/16/17/18	1N4148 SW		SDSIT0006- or

*Mylar is a registered trademark of E.I. Du Pont de Nemours and Company.

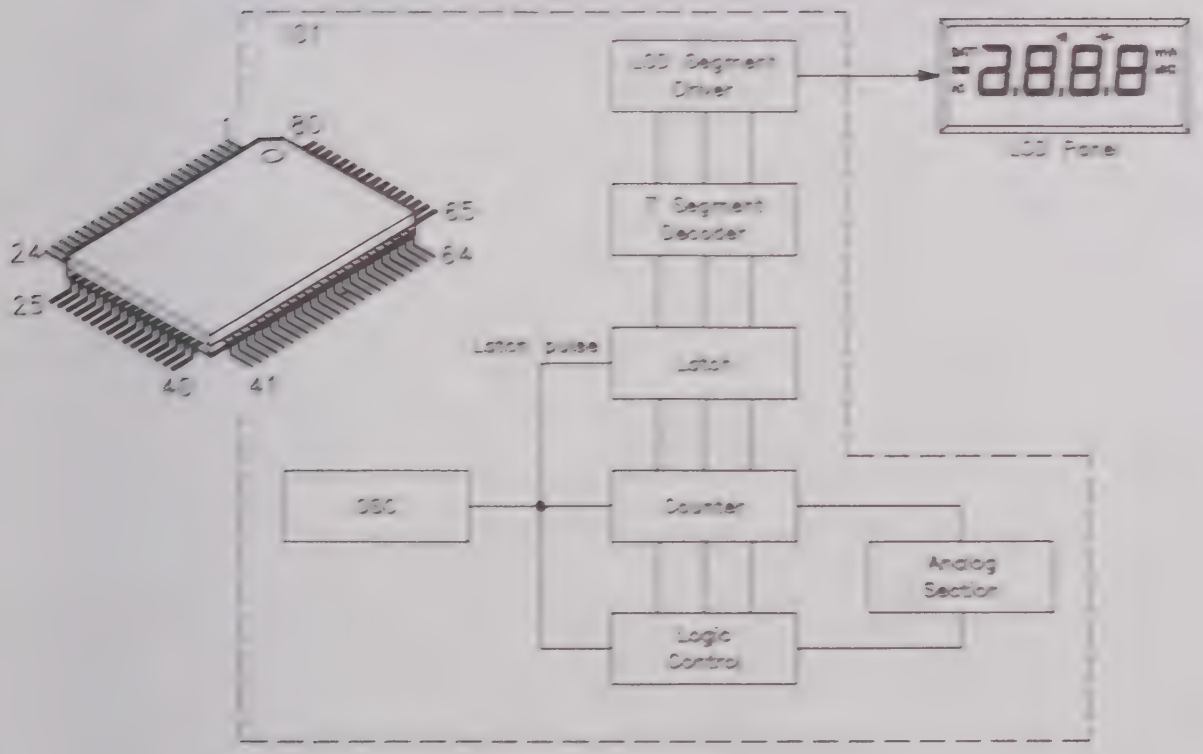
Ref. No.	Description	RS Part No.	Mfr's Part No.
DIODES (All Silicon Type, Unless Noted Otherwise)			
D 15/16/17/18	1N4148		SDSIT0146- or
	1N4148		SDSIT6049-
D 19/20/21	1N4148 SW		SDSIT0006- or
	1N4148		SDSIT0146- or
	1N4148		SDSIT6049-
IC			
IC 1	SMC4301F0A AC/DC Convert		SIS14301FA
POSISTOR			
PO 1	911P84E102YU13		SDPS00015-
TRANSISTOR			
Q 1	2SD400(E) NPN Protection		ST2D400--E or
	2SD400(F)		ST2D400--F or
	KSD471AYC		STSD471--Y
RESISTORS (All M-Film 1/4W ± 1% Type, Unless Noted Otherwise)			
R 1	10 Mohm 1/2W + −0.5%		RM0HP106D*
R 2	750 kohm		RMSQR754F*
R 3	118 kohm For CAL		RMSQRA20F* or
	123 kohm For CAL		RMSQUA25F*
R 4	107 kohm For CAL		RMSQRA19F* or
	110 kohm For CAL		RMSQ114F*
R 5	750 kohm		RMSQR754F*
R 6	220 kohm		RMSQR224F*
R 7	30 kohm		RMSQR303F*
R 8	51 kohm		RMSQR513F*
R 9	33 kohm		RMSQR333F*
R 10	5 kohm		RMSQR502F*
R 11	27 kohm		RMSQR273F*
R 12	22 kohm		RMSQR223F*
R 13	330 kohm		RMSQR334F*
R 14	22 kohm		RMSQR223F*
R 15	330 kohm		RMSQR334F*
R 16	22 Mohm 1/2W + −5%		RM0HP226J*
R 17	90 ohm		RMSQR900F*
R 18	9 ohm		RMSQR9R0F*
R 19	0.87 ohm For CAL		RMSQUR87F* or
	0.88 ohm For CAL		RMSQUR88F* or
	0.89 ohm For CAL		RMSQUR89F*
R 20	Carbon 10 kohm 1/4W + −5%		RCSQR103J*
R 21	1.11 Mohm 1/4W + −0.5%		RMSQRA02D*
R 22	101 kohm 1/4W + −0.5%		RMSQRA01D*

Ref. No.	Description	RS Part No.	Mfr's Part No.
RESISTORS (All M-Film 1/4W ± 1% Type, Unless Noted Otherwise)			
R 23	10 kohm 1/4W + −0.5%		RMSQR103D*
R 24	1 kohm 1/4W + −0.5%		RMSQR102D*
R 25/ 26	Carbon 330 kohm 1/4W + −5%		RCSQR334J*
R 27	164 ohm		RMSQRA05F*
R 28	1.64 kohm		RMSQRA04F*
R 29	16.4 kohm		RMSQRA03F*
R 30	164 kohm		RMSQRA18F*
R 31	1.64 Mohm		RMSQRA17F*
R 32	16.4 Mohm 1/2W + −1%		RM0HPA01F*
R 33	Wire, Resist D1.6 MANGANIN		W5A1R6MT-Y
SWITCHES			
SW 1	Rotary 2C-6P L10 D-CUT Function		181110220A
SW 2	Slide 4C-3P L2 For ON/OFF		183111520A or
	Slide 4C-3P L2		183111521A
SW 3	Rotary 2C-6P L10 D-CUT Range		181110210B
POTS			
VR 1	Semi-Fixed 10KB VM6CK-PV(1S)DCV ADJ		177110990A
VR 2	Semi-Fixed 200KB VM6CK-PV(1S)ACV ADJ		177111030A
CRYSTAL			
X 1	32768Hz M56-16		391010070A or
X 2	32768Hz DT-26S		391011470A
MISCELLANEOUS			
	Contact, Battery C5210R Ni-3		198110840A or 198110850A or 198110860A
	Spring, Coil SWP Ni-3 Large		434110450A
	Spring, Coil SWP Ni-3 Small		434110680A
	Terminal, Tester C3601BD Ni-3 Test Lead		194510170A
	Clip, Fuse UF-0033#01		197303320C
	Eyelet, 1.3 × 2.5 (36 Pcs)		HAE21325BA
	End Of Assembly, PCB, Main		

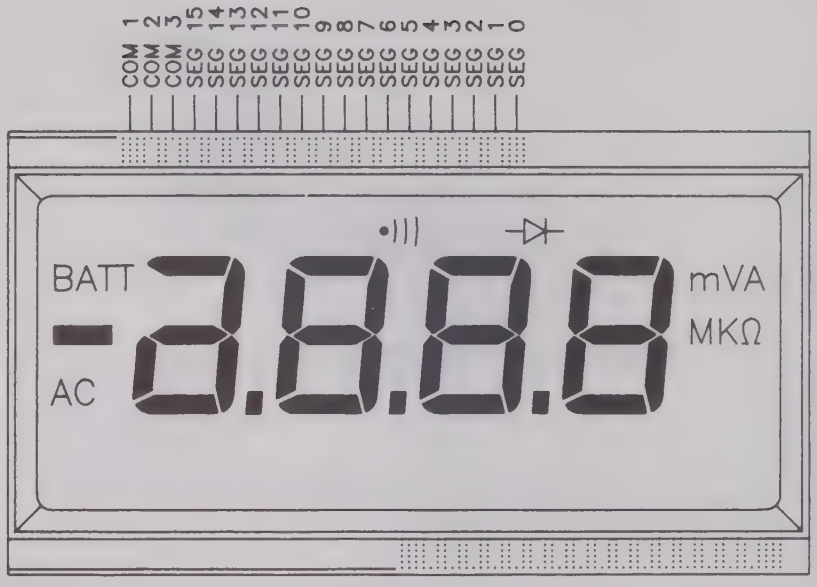
TRANSISTOR LEAD IDENTIFICATION

IC INTERNAL DIAGRAM

IC1 SMC 4301 FOA7 BLOCK DIAGRAM



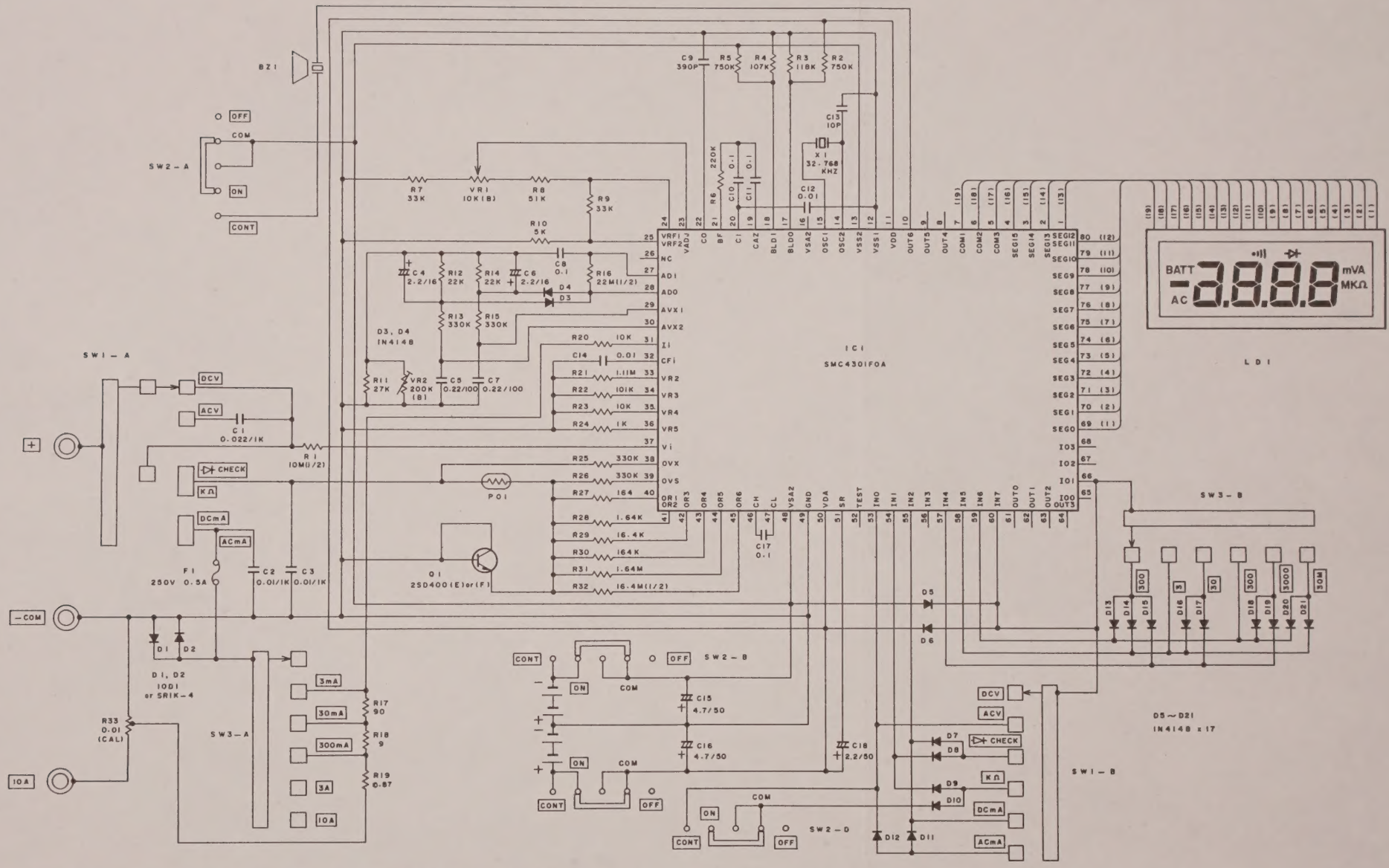
LCD PIN CONFIGURATION



NOTE

NOTE

SCHEMATIC DIAGRAM (Cat. No.22-183)



Notes: (1) All resistance values are indicated in "OHMS" (K = 10^3 OHMS, M = 10^6 OHMS).
(2) All capacitance values are indicated in "μF" (P = 10^{-6} μF).
(3) SWITCHES: SW1 FUNCTION SELECT SW (ROTARY).
SW2 POWER SW WITH CONTINUITY (SLIDE).
SW3 RANGE SELECT SW (ROTARY).

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